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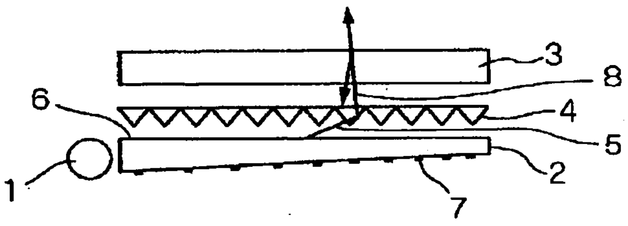
(71)出願人　000002897
大日本印刷株式会社
東京都新宿区市谷加賀町一丁目１番１号
(72)発明者　鹿島　啓二
東京都新宿区市谷加賀町一丁目１番１号
大日本印刷株式会社内
(72)発明者　荒川　文裕
東京都新宿区市谷加賀町一丁目１番１号
大日本印刷株式会社内
(74)代理人　弁理士　小西　淳美

(54)【発明の名称】　バックライト及び液晶表示装置

(57)【要約】
【課題】　バックライト及び液晶表示装置において光利用効率を向上させる。
【解決手段】　光源１と、該光源からの光を側面から入射し、第１の所定方向に最大強度を有する指向性光を出射する導光体２と、平面状多層構造を有する偏光分離体３と、前記導光体と偏光分離体との間に介在し、前記第１の所定方向の光を、偏光分離体の偏光分離作用が最大となるような第２の所定方向に偏向させて偏光分離体へ向けて出光する光線偏向体４とからバックライトを構成する。



【特許請求の範囲】

【請求項１】　光源と、該光源からの光を側面から入射し、第１の所定方向に最大強度を有する指向性光を出射する導光体と、平面状多層構造を有する偏光分離体と、前記導光体と偏光分離体との間に介在し、前記第１の所定方向の光を、偏光分離体の偏光分離作用が最大となるような第２の所定方向に偏向させて偏光分離体へ向けて出光する光線偏向体と、からなるバックライト。

【請求項２】　導光体が、形状が略平板状であり、且つ、導光体における光散乱手段として、導光体の出射面又は出射面とは反対側の面に光散乱層が光学的に接触しているか、導光体の出射面又は出射面とは反対側の面が粗面であるか、又は導光体の内部が光散乱性を有する、いずれかである、請求項１記載のバックライト。

【請求項３】　光線偏向体が、導光体側の断面形状及び／又は導光体側とは反対側の断面形状が、複数の単位プリズムからなる凹凸面を有するプリズムシートである請求項２記載のバックライト。

【請求項４】　偏光分離体の平面状多層構造が、隣接する層が互いに屈折率の異なる３層以上の層からなる、請求項１～３のいずれか１項に記載のバックライト。

【請求項５】　偏光分離体が、コレステリック液晶層からなる旋光選択層と、λ／４位相差層とを有する、請求項１～４のいずれか１項に記載のバックライト。

【請求項６】　偏光分離体の平面状多層構造が、平面内で互いに直交する2方向の光振動方向に於いて、一方の方向での隣接する層間の屈折率差と、他方の方向での隣接する層間の屈折率差とが異なる、３層以上の層からなる、請求項１～３のいずれか１項に記載のバックライト。

【請求項７】　液晶セルの背面光源として、請求項１～６のいずれか１項に記載のバックライトを用いた、液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、液晶表示装置等に用いる光利用効率の良いバックライト、及び液晶表示装置に関する。

【０００２】

【従来の技術】近年、ディスプレイとして、バックライトを用いた液晶表示装置の普及には目覚ましいものがあり、現在普及している液晶表示装置は、偏光光（偏光板に光を透過させることによって得ている）を液晶層で変調する方式である。図１１に従来のバックライト及び液晶表示装置の代表的な構成を示す。同図で従来のバックライトの作用を説明すると、光源２１から出射された光は導光体２２に入射し全反射を繰り返しながら進行する。導光体内を進行する光の一部は光散乱体２３で進行方向を変えられて導光体外へ出射する。導光体から図面下方向に出射した光は反射シート２４で反射されて再び導光体内部へ戻され、一方、図面上方に出射した光は拡散シート２５で拡散された後、プリズムシート２６で集光されて、表裏を偏光板３１、３２で挟持された液晶セル３０の照明光として使用されるというものである。そして、偏光板３１及び３２で表裏を挟持された液晶セル３０の背面光源として使用される。また、図１２及び図１３も従来のバックライト及び液晶表示装置を示すものであり、図１２に於けるバックライトでは、図１１に対して、拡散シート２５とプリズムシート２６と順番が逆になり、且つプリズムシートのプリズム面が導光体側を向いた構成である。また、図１３に於けるバックライトでは、プリズムシート２６の上に、プリズムシート２６の三角柱プリズムの向きと直交する三角柱プリズムを持つ別のプリズムシート２６ａを重ねた構成である。

【０００３】しかし、現在使用されている偏光板は入射光の約半分を吸収してしまうために、光の利用効率が低かった。そこで、満足のいく明るさにする為には、より多くの光を偏光板に入射させていた。しかし、その分光源の消費電力が増大するばかりでなく、光源からの熱が液晶に悪影響を与えて表示が見づらくなってしまう等の様々な深刻な問題があった。

【０００４】この様な観点から現在に至るまで以下の如き様々な提案がなされてきた。それらは、光源からの無偏光光を、互いに直交関係にある二つの直線偏光に分離する偏光分離体を用い、分離された一方の偏光光を直接利用すると共に、他方の偏光光も再利用するものである。すなわち、偏光分離体により分離した偏光成分のうち、片方の偏光成分は液晶セルに入射させ、他方の偏光成分は光源側に戻して、その光を反射等により再度偏光分離体に導いて再利用することで、光利用効率を向上させる技術である。

①特開平４－１８４４２９号公報に開示の技術は、偏光分離器にて光源装置からの無偏光光を互いに直交関係にある二つの偏光光に分離し、一方の偏光光は直接液晶セルに向けて出射させ、もう一方の偏光光は光源側に戻して集束させた後、反射させて再び光源光として再利用するものである。

②特開平６－２６５８９２号公報に開示のバックライトでは、面状導光体の光出射面側に、出射する光が面状導光体表面に対してほぼ垂直になるような光線偏向体を設け、さらにその上に、偏光分離手段を配置するものである。

③また、特開平７－２６１１２２号公報に開示のバックライトでは、楔形状断面を有する体積領域を含む光散乱導光体からなる平行光束化素子の出射面側に、偏光分離体を配置するものである。

【０００５】

【発明が解決しようとする課題】しかしながら、上記従来の各技術には次のような問題があった。①の技術は、投影型の液晶表示装置を対象とするものであり、その照

明装置の構成は空間的スペースを必要とし、薄型化が要求される平面型の液晶表示装置には適用できない。②の技術は、薄型化に適したものであるが、その偏光分離体は、その断面が三角形状の柱状プリズムアレイの斜面に偏光分離層を形成したものである場合には、優れた光利用効率が得られているが、偏光分離体の構造が複雑で、特に断面が三角形状の柱状プリズムアレイの斜面部分に偏光分離層を形成することが難しく、量産性に優れたものとは言い難かった。③の技術は、導光体として楔形状断面を有する体積領域を含む特定の光散乱導光体からなる平行光束化素子を用いた場合には、優れた光利用効率が得られているが、光散乱導光体を特定の光散乱能にすることが難しく、一般的に使用できるものとは言い難かった。

【０００６】そこで本発明の目的は、比較的簡単な構成で厚みも薄くでき且つ量産性に優れ、光の利用効率を向上できる偏光分離体として偏光分離フィルムを提供することである。

【０００７】

【課題を解決するための手段】そこで上記課題を解決する為に本発明のバックライトは、光源と、該光源からの光を側面から入射し、第１の所定方向に最大強度を有する指向性光を出射する導光体と、平面状多層構造を有する偏光分離体と、前記導光体と偏光分離体との間に介在し、前記第１の所定方向の光を、偏光分離体の偏光分離作用が最大となるような第２の所定方向に偏向させて偏光分離体へ向けて出光する光線偏向体とから構成した。この結果、光源からの光の利用効率が向上する。また、本発明の偏光分離体は平面状であるので、厚みも薄くかさばらず、薄いバックライトにできる。なお、導光体は、形状が略平板状であり、且つ、導光体における光散乱手段として、出射面又は出射面とは反対側の面に光散乱層が光学的に接触しているか、導光体の出射面又は出射面とは反対側の面が粗面であるか、又は導光体の内部が光散乱性を有するものを用いると良い。また光線偏向体には、導光体側の断面形状及び／又は導光体側とは反対側の断面形状が、複数の単位プリズムからなる凹凸面を有するプリズムシートを用いると良い。また、偏光分離体の平面状多層構造は、隣接する層が互いに屈折率の異なる３層以上の層から構成すると良い。ま、偏光分離体の平面状多層構造が、平面内で互いに直交する２方向の光振動方向に於いて、一方の方向での隣接する層間の屈折率差と、他方の方向での隣接する層間の屈折率差とが異なる、３層以上の層から構成すると良い。また、偏光分離体としては、コレステリック液晶層からなる旋光選択層と、λ／４位相差層とを有する構成とすると良い。そして、本発明の液晶表示装置は、液晶セルの背面光源として上記バックライトを用いた構成とした。

【０００８】以下、図面を参照しながら、本発明のバックライト及び液晶表示装置について詳述する。

【０００９】先ず、図１は、本発明のバックライトの構成の一形態を示す断面図である。本発明のバックライトは、同図に示す如く、少なくとも、光源１と、該光源からの光を側面から入射し、第１の所定方向に最大強度を有する指向性光を出射する導光体２と、平面状層構造を有する偏光分離体３と、前記導光体と偏光分離フィルムとの間に介在し、前記第１の所定方向の光を、偏光分離体の偏光分離作用が最大となるような第２の所定方向に偏向させて偏光分離体へ向けて出光する光線偏向体４と、から構成される。光源は冷陰極管などを使用する。

【００１０】導光体２は、側面から入光した光源光を出射面から出射するものであり、図１～図６に例示するように、第１の所定方向（図中の符号５）に最大強度を有する指向性光を出射する特性を有するものである。導光体の材質は光を効率良く透過させる性質があれば特に限定されず、例えばＰＭＭＡ等のアクリル樹脂、ポリカーボネート樹脂、ガラス等である。第１の所定方向５は、図１～図５に示した様に、一般的には導光体の出射面６を基準に考えると、導光体出射面の法線方向に対して、導光体の側端面近傍に配置した光源１とは反対側の方向である。第１の所定方向５に最大輝度を有する指向性光として例えば拡散光（この拡散光は指向性が全く無い完全拡散光ではない）を導光体から出射する方法として、導光体の形状を略平板状（厳密には光源を配置する導光体側端面から遠ざかるにつれて厚みが薄くなる楔形状など）として、導光体２に光散乱手段を備えさせる。光散乱手段としては、①導光体の出射面に樹脂中にシリカ等の光散乱剤を分散させた光散乱層を印刷等で設けて光学的に接触させるか、②導光体の出射面とは反対側の面に樹脂中にシリカ等の光散乱剤を分散させた光散乱層７（通常はドット状等とする）を印刷等で設けて光学的に接触させるか（図２）、③導光体の出射面を粗面とするか（図３）、④出射面とは反対側の面（裏面）を粗面とするか（図４）、⑤導光体の内部に光散乱剤として、導光体の大部分を構成する物質（例えばＰＭＭＡ：屈折率１．４９）とは異なる屈折率を有する透光性の物質（例えば、シリコーン樹脂：屈折率１．４３）を粒子径５μm以下の大きさで導光板全体の１重量％以下含有させて導光体の材料自身を光散乱性とする（図５）の、いずれかを採用すれば良い。粒子径が５μmより大きいと導光体からの出射光の指向性が完全拡散光に近づき、また含有量が１重量％を越えても導光体出射面の輝度均一性が悪化し好ましくない。なお、導光体の厚みを光源から遠ざかるにつれて薄くする際に、光源を両側端面近傍に設けるいわゆる２灯式バックライトの場合には、図６の示すように、導光体は中央部分が最も薄い形状とし、また、２方向の第１の所定方向５、５ａが存在することになる。

【００１１】光線偏向体４は、図７及び図８に示すように、導光体２から出射する第１の所定方向５の光を入光

して、第２の所定方向８の光として出光する、光線の進路を変更する手段である。図７の構成のバックライトでは、光線偏向体４は、断面が三角形の三角柱の三角プリズムを単位プリズムとして、単位プリズムを多数配列したプリズム構造を有し、プリズム構造による凹凸により導光体側の断面形状が略Ｖ字形状を成すプリズムシートである。この場合、導光体から出射した第１の所定方向の光線を、プリズムシートに入光後、プリズム内部の全反射によって第２の所定方向に変えて出射する。なお、図７では、三角柱プリズムの断面三角形の斜面は、光源側を反光源側よりも急斜面とした不等辺三角形である。これは、導光体出射面から傾いて出光する指向性光について、光線偏向体で例えば法線方向等へ傾きを立てる為である。また、図８の構成のバックライトにおけ光線偏向体４は、図７とは逆に導光体側とは反対側の断面形状が略Ｖ字形状を成す多数の三角プリズムからなるプリズムシートである（図７のプリズムシートとはプリズム側を表裏逆に配置した構成である）。この場合は、導光体から出射した第１の所定方向５の光線を、光線偏向体４の入射面及び出射面のプリズムによる屈折作用により、第２の所定方向８の光線として、進行方向を偏向して出射する。なお、図８では、三角柱プリズムの断面三角形の斜面は、反光源側を光源側よりも急斜面とした不等辺三角形である。これは、導光体出射面から傾いて出光する指向性光について、光線偏向体で例えば法線方向等と傾きを立てる為である。しかし、指向性が弱い場合は、二等辺三角形でも良い。これらのプリズムシートとしては、光を効率よく透過させる性質の材料であれば機能し、例えば、ポリカーボネート（ＰＣ）、ポリエチレンテレフタレート（ＰＥＴ）等のポリエステル樹脂、ポリメチルメタクリレート（ＰＭＭＡ）等のアクリル樹脂、ガラス等がある。なかでも、微細なプリズム形状を精度よく形成できる点で、ＰＥＴ、ＰＣなどのベースフィルムの上に紫外線硬化樹脂を用いてプリズム形状を形成したプリズムシートが好ましく、又、最も量産性に優れた点からも好ましい。この場合、紫外線硬化樹脂で形成したプリズムの屈折率は大きい方が好ましく、具体的には１．４以上、更に好ましくは１．５以上である。なお、ベースフィルム上に紫外線硬化樹脂でプリズム形状を形成するには、特開平５－１６９０１５号公報に開示の技術を利用すれば良い。すなわち、プリズム形状とは逆凹凸形状の凹部を有する回転するロール凹版に紫外線樹脂液を塗工充填し、次いでこれにベースフィルムを供給して版面の樹脂液の上からロール凹版に押圧し、押圧した状態で、紫外線照射して樹脂液を硬化させた後に、固化した紫外線硬化樹脂をベースフィルムと共に回転するロール凹版から剥離すれば、プリズムシートは連続製造できる。

【００１２】本発明の偏光分離手段３としては、形状が平面状で多層構造を有するものを使用する。図１０に互いに屈折率の平面状多層構造の偏光分離体４１を用いたバックライトの一形態を示す。偏光分離体４１は、平面状多層構造を有し、互いに隣接した平面状物質層同士の屈折率が異なる。平面状物質層は透光性があればその材質は特に限定されず、ポリエチレンテレフタレート（ＰＥＴ）等のポリエステル樹脂、ポリカーボネート（ＰＣ）、ポリメチルメタクリレート（ＰＭＭＡ）等のアクリル樹脂、ＴＡＣ（三酢酸セルロース）、ガラス、シリカ、ＩＴＯ（Indium Tin Oxide）等である。互いに屈折率の異なる平面状多層構造を有する偏光分離体は、屈折率の異なる界面を光線が透過する際に、透過光及び反射光が偏光される現象（偏光分離作用）を利用するものである。この偏光分離作用が最も強化される光線入射角はブリュースター角度として知られている。なお、光線入射角がブリュースター角度の場合、例えば空気（屈折率ｎ＝１）中の一枚の平面状物質（屈折率ｎ′＞ｎ）を用いれば、反射光のＳ波と透過光のＰ波の強度比$Ts/Tp=(2n'/1+n'^{2})^{4}$となり、強い偏光分離作用を得る為には、平面状物質層は少なくとも２層以上の多層とするが、好ましくは３層以上、より好ましくは５層以上の多層構造とする。なお、ここでＰ波は光の振動面が入射面に平行な光、Ｓ波は光の振動面が入射面に垂直な光の意味である。このような偏光分離体に無偏光光が入射すると、直線偏光した光のうちＰ波成分の多い光線が透過されると共に、それ以外のＳ波成分の多い光線は反射されて、導光体側に向けて進行する。反射光は、透過光とは偏光面が直交する直線偏光光である。そして、導光体に戻された光線は、通常は導光体が備えた光散乱機能によって、偏光状態から無偏光な状態へと変換され、再び偏光分離体へ出射して再利用される。導光体から出射された光線がこのような経路をたどることによって、極めて効率良く光量ロス少なく、偏光光が得られるのである。なお、偏光状態から無偏光な状態への変換は、導光体の裏面側等に配置する反射シート等を利用する事もできる。

【００１３】また、本発明の偏光分離手段３は平面状多層構造であり、少なくとも２層以上で構成されるが、この様な構造を有するものとしては、例えば、図１６に示したように、屈折率異方性を有する層を、その主軸が交互に異なる様に積層した多層構造を用いることも出来る。屈折率異方性を有する層は、例えば、特開平３－７５７０５号公報に開示されているように、ポリカーボネート系樹脂、ポリエステル系樹脂、ポリビニルアルコール系樹脂、酢酸セルロース系樹脂等の面内屈折率異方性を示す物質であれば良く、それらを延伸する等の方法によって得ることができる。図１６中、５０は、平面内で互いに直交する２方向の光振動方向に於いて、一方の方向での隣接する層間の屈折率差と、他方の方向での隣接する層間の屈折率差とが異なる、３層以上の層からなる平面状多層構造体による偏光分離体５０である。同図で

は、このような平面状多層構造体からなる偏光分離体５０を、屈折率異方性を有する層５１～５４がこの順に積層した４層の構成で概念的に示してある。例えば、層５１、５２、５３及び５４のｘ軸方向に振動する光線に対する屈折率は実質的にn_Xで同じであり、したがって、ｘ軸方向での隣接する層間の屈折率差Δn_X（＝｜$n_X - n_X$｜）は実質的にゼロである。そして、層５１及び層５３のｙ軸方向に振動する光線に対する屈折率は、共にn_{Y1}であり、層５２及び層５４のｙ軸方向に振動する光線に対する屈折率は、共にn_{Y2}（$n_{Y1} \neq n_{Y2}$）であり、したがって、ｙ軸方向での隣接する層間の屈折率差Δn_Y（＝｜$n_{Y1} - n_{Y2}$｜）は実質的にゼロでは無い。これらより、ｘ軸方向での隣接層間の屈折率差Δn_Xと、ｙ軸方向での隣接層間の屈折率差Δn_Yとは実質的に異なるような状態である。このような、平面内で互いに直交する２方向の光振動方向に於いて、一方の方向での隣接層間の屈折率差と、他方の方向での隣接層間の屈折率差とが異なる平面状多層構造体からなる偏光分離体を用いると、偏光を分離できる。つまり、屈折率差の大きい方の方向（例えばｙ軸方向）に振動する光の反射は屈折率差の小さい方の方向（例えばｘ軸方向）に振動する光の反射よりも大きく、屈折率差の小さい方の方向（例えばｘ軸方向）に振動する光の透過は屈折率差の大きい方の方向（例えばｙ軸方向）に振動する光の透過よりも大きい。そして、より好ましい態様は、小さい方の屈折率差が実質的にゼロの場合である。そうすれば、小さい方の屈折率差を与える方向に振動する光は反射せず透過する。つまり、平面内で互いに直交する２方向の光振動方向に於いて、一方の方向（例えばｘ軸方向）では隣接層間の屈折率が実質的に同じであり、もう一方の方向（例えばｙ軸方向）では隣接層間の屈折率差が異なる平面状多層構造からなる偏光分離体を用である。このような偏光分離体を用いると、より好ましい状態で偏光を分離（例えば、ｘ軸方向に振動する光を透過し、ｙ軸方向に振動する光を反射）することが出来る。もちろん、この場合でも、大きい方の屈折率差の値が大きい方が偏光分離性能が高い。その理由は、上記の例で説明すると、ｘ軸方向に振動する光に取って、平面状多層構造体内の屈折率は実質的に均一なので、平面状多層構造体の入射面及び出射面の２カ所で僅かな表面反射が起こるだけである。しかし、ｙ軸方向に振動する光に取っては、平面状多層構造体内の屈折率は隣接するそれぞれの層間で異なっているので、平面状多層構造体の入射面及び出射面、並びに平面状多層構造体内のそれぞれの層間で表面（界面）反射が起こる。従って、偏光分離体の層数が多ければ多いほど表面（界面）反射が起こり、ｙ軸方向に振動する光を反射するのである。この場合、偏光分離作用が最大となる光線の入射角は、平面状多層構造体の面に立てた法線方向近傍である。なお、偏向分離の状態を測定する方法としては、互いに光の振動方向が直交するような直線偏光を用いることが出来る。

【００１４】また、本発明の偏光分離手段３となる平面状多層構造を有する偏光分離体としては、液晶、特にコレステリック液晶を利用した偏光分離フィルムを用いることもできる。コレステリック液晶はヘリカルな分子配列に基づいて上記のような旋光選択特性を発現するが、プレナー配列のヘリカル軸に平行に入射した光は右旋光と左旋光の２つの円偏光に分かれ、一方は透過し他方は反射される。この現象は円偏光２色性として知られており、円偏光の旋光方向を入射光に対して適宜すると、コレステリック液晶のヘリカル軸方向と同一の旋光方向を持つ円偏光が選択的に散乱反射される。最大の旋光光散乱は、次の式１の波長λ_0で生じる。

【００１５】$\lambda_0 = n_{AV} \cdot p$　〔式１〕

【００１６】ここで、ｐはヘリカルピッチ、n_{AV}はヘリカル軸に直交する平面内の平均屈折率である。このときの反射光の波長バンド幅$\Delta\lambda$は、次の式２で示される。

【００１７】$\Delta\lambda = \Delta n \cdot p$　〔式２〕

【００１８】ここで、$\Delta n = n_{\parallel} - n_{\perp}$である。$n_{\parallel}$はヘリカル軸に直交する面内における最大の屈折率、$n_{\perp}$はヘリカル軸に平行な面内における最大の屈折率である。また、プレナー配列のヘリカル軸に対して斜めに入射した光の選択散乱光の波長$\lambda\psi$は、λ_0に比べて短波長側にシフトすることが知られている。上記の特性を利用して、或る波長の光のみを選択的に利用することも可能であるし、反射光の波長バンド幅$\Delta\lambda$が全可視光域をカバーする様に、コレステリック液晶のヘリカルピッチｐと屈折率差Δnを制御することで、白色光に対しても用いることも可能となる。

【００１９】コレステリック液晶としては、シッフ塩基、アゾ系、エステル系、ビフェニル系等のネマチック液晶化合物の末端基に光学活性の２－メチルブチル基、２－メチルブトキシ基、４－メチルヘキシル基を結合したカイラルネマテック液晶化合物が望ましい。また、コレステリック液晶としては、高分子コレステリック液晶が、常温固体で且つそのカイラルな物性を固定できる点で、好ましい材料の一つである。一般に高分子液晶は、液晶を呈するメソゲン基を主鎖、側鎖、或いは主鎖及び側鎖の位置に導入した高分子であるが、高分子コレステリック液晶も、例えばコレステリル基を側鎖に導入することで得ることができる。この場合、側鎖にコレステリル基を導入するには、ポリシロキサン、或いはエチレン－酢酸ビニル共重合体等のビニルポリマー等の主鎖ポリマーに、適当な距離を隔てるスペーサ（分子）を介して導入したり、或いはコレステリル基を有するビニルモノマーを重合することによって得られる。

【００２０】コレステリック液晶による偏光分離作用は、コレステリック液晶で一方の円偏光成分（右回り又は左回り）が透過され、他方の円偏光成分が反射する。液晶表示装置としては、通常、円偏光ではなく、直線偏

光を入射光として利用するので、円偏光を直線偏光に変換する１／４位相差板を併用することが好ましい。なお、このコレステリック液晶及び１／４位相差板の作用については、例えば、「SID 90 DIGEST, p110～110, Polariaing Color Filters Made From Cholesteric LCSiliconer」等で報告されている。コレステリック液晶を用いる場合は、コレステリック液晶層とλ／４位相差層とは、密着させずに間に空気層や他の中実の物質層を介在させた偏光分離手段として用いても良いが、両層は密着させて少なくとも２層構造の平面状２層構造体とするのが好ましい。コレステリック液晶層とλ／４位相差層とを密着積層させた偏光分離体は、フィルム状の偏光分離体として使用することができる。もちろん、配置は、λ／４位相差層側を液晶セル側に、コレステリック液晶層側を導光体側にして用いる。コレステリック液晶層とλ／４位相差層とを別体としても原理的には良いが、固体／気体間の界面での反射により光量ロスが生じる上、部品点数も多くなり好ましくない。コレステリック液晶層による偏光分離作用が最も強化される光線入射角度は、コレステリック液晶の配向方向に依存するが、偏光光線の最大強度が平面状の偏光分離体に立てた法線方向にほぼ一致するように、コレステリック液晶の配向方向をそろえることが、液晶表示装置への応用の観点から最も好ましい。コレステリック液晶の配向をそろえるには、高分子フィルム等の基材を公知のラビング法でラビングした上にコレステリック液晶を塗布するか、又は公知の偏光光を用いる紫外線配向技術を用いても良い。

【００２１】なお、コレステリック液晶の偏光分離作用を使用する場合、コレステリック液晶層の界面での前記ブリュースター角度による偏光分離作用と、コレステリック液晶の偏光分離作用とが合わさったものとなる。その方向が遠い場合には２峰性の特性となるだけだが、近い場合には強め合う。しかし、その方向は、通常は、コレステリック構造の螺旋軸方向にほぼ一致する。

【００２２】以上の様に、本発明のバックライトでは、導光体から出射した第１の所定方向に最大強度を有する拡散光等の指向性光の出射方向を、前述した光線偏向体を用いて、第２の所定方向（偏光分離体の偏光分離作用が実質的に最大となる様な方向）に偏向させて、上記したような平面状多層構造の偏光分離手段にさせることができる。その結果、偏光分離手段の偏光分離能力を最大限に生かして、光利用効率を向上できることとなる。しかも、偏光分離体は平面状なので、多層膜を斜面に有する場合に比べて、薄型のバックライトになり、かさばらない。

【００２３】なお、本発明のバックライトは、更に必要に応じて、従来公知のバックライト（図１１～図１３参照）と同様に、拡散シート、レンズシート等を併用しても良く、本発明の趣旨を逸脱しない範囲で、本説明に限定されるものではない。

【００２４】そして、本発明の液晶表示装置は、上記バックライトを液晶セルの背面光源として用いることで構成することができる。

【００２５】

【実施例】以下、実施例及び比較例により、更に本発明を説明する。

【００２６】（実施例１）図１４に示す様に、光源１、斜め方向に最大強度を有する拡散光線を出射し、裏面にはドット状の光散乱層７を印刷形成した導光体２、偏光分離体４２として、入射面側から順にＰＥＴ（ポリエチレンテレフタレート樹脂）層４３、コレステリック液晶層（コレステリック構造の螺旋軸方向はＰＥＴ層面の法線方向）４４、λ／４位相差層４５、ＴＡＣ（三酢酸セルロース樹脂）層４６からなる平面状多層構造体、単位プリズムが三角柱プリズム（断面が光源側を反光源側よりも急斜面とした不等辺三角形）からなりプリズム凹凸を、導光体側に向けたプリズムシートである光線偏向体４、そして、白色ポリエチレンテレフタレートシートからなる光拡散反射シート９を導光体裏面側近傍に配置し、前記光線偏向体４と偏光分離体４２との間に拡散力が弱い拡散シート１０を配置した構成のバックライトを作製した。このとき、液晶パネル（図示せず）の導光体側の偏光板の偏光光の透過方向軸と偏光分離体４２から出射する光線の偏光軸を一致させて、最も良く偏光光が透過するような配置とした。光源からの光線は、導光体２内部で全反射して出射面から斜め方向に出光し、この光線を光線偏向体４のプリズム内で全反射させて、図面でほぼ上向きの光線に変換後、偏光分離体４２を通して、２枚の偏光板間にＴＮ型液晶を有する液晶パネルに入射させた。

【００２７】液晶パネルを透過モードにして、パネル表面の偏光板から出射される光線の輝度を測定したところ、従来の図１１に示したようなバックライトを使用した場合と比較して、最大輝度（最大値を与える方向の輝度）は４０％向上した。このときのバックライトの総厚は６ｍｍとなり、いわゆる直下型バックライトを使用した場合の総厚の１／１０以下になった。

【００２８】（実施例２）また、実施例１のバックライトにおいて、光線偏向体に、単位プリズムとして断面が頂角９０°の二等辺三角形の三角柱プリズムを用い、且つプリズム凹凸面の向きを液晶セル側と逆向構成とした他は、実施例１同様に、実施例２のバックライトを作製し、実施例１同様に輝度を評価した。最大輝度は２０％向上した。

【００２９】（比較例１）実施例２において、同じ偏光分離体を用いて、導光体出射面側から順に偏光分離体、プリズムシート（プリズム面は液晶セル側）の配置で構成したバックライトを作製し、実施例１同様に輝度を評価した。最大輝度の向上は５％と少なかった。

【００３０】（実施例３）図１５に示す如く、偏光分離

体４７として、ポリカーボネート樹脂層４８と、ポリメチルメタクリレート樹脂層４９とが交互に隣接して合計５０層積層した構成の、平面状多層構造を有する偏光分離体を用い、その他は実施例１同様に、バックライトを作製し、実施例１同様に輝度を評価した。最大輝度は６０％向上した。

【００３１】（実施例４）また、実施例１及び２の偏光分離体４２に代えて、図１６に示すようなポリエステル樹脂を延伸したものを、その屈折率の主軸が交互に直交するように熱圧着して積層した１００層からなる偏光分離体５０を用いたところ、それぞれ実施例１及び２と同様な輝度向上効果が得られた。

【００３２】（比較例２）実施例１～４において、偏光分離体に入射する指向性光の最大強度方向を、偏光分離体の偏光分離作用が最大となる方向からずらせばずらす程、輝度は低下した。特に、１０度以上ずらした場合の輝度低下は顕著であり、２５度以上ずらすと色の変化がはっきりと観察された。

【００３３】

【発明の効果】本発明によれば、比較的簡単な構成で光の利用効率を向上できる。しかも、バックライトの偏光分離体が平面状なので厚みも薄くでき、液晶表示装置の薄型化に最適である。

【図面の簡単な説明】

【図１】本発明のバックライトの一形態を示す断面図。

【図２】導光体の一形態を示す断面図。

【図３】導光体の他の形態を示す断面図。

【図４】導光体の他の形態を示す断面図。

【図５】導光体の他の形態を示す断面図。

【図６】導光体の他の形態を示す断面図。

【図７】光線偏向体の一形態を示す断面図。

【図８】光線偏向体の他の形態を示す断面図。

【図９】光線偏向体の形状例を示す斜視図。

【図１０】偏光分離手段に多層構造を用いた本発明のバックライトの一形態を示す断面図。

【図１１】従来のバックライト及び液晶表示装置の一例を示す断面図。

【図１２】従来のバックライト及び液晶表示装置の他の例を示す断面図。

【図１３】従来のバックライト及び液晶表示装置の他の例を示す断面図。

【図１４】偏光分離手段にコレステリック液晶による多層構造を用いた、本発明のバックライトの他の形態を示す断面図。

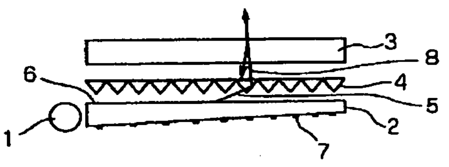
【図１５】偏光分離手段にブリュースター角度利用の多層構造を用いた、本発明のバックライトの他の形態を示す断面図。

【図１６】屈折率異方性を有する層からなる平面状多層構造を有する偏光分離体の一例を示す斜視図。

【符号の説明】

１	光源
２	導光体
３	偏光分離体
４	光線偏向体
５	第１の所定方向
６	導光体の出射面
７	光散乱層
８	第２の所定方向
９	反射シート
１０	拡散シート
３０	液晶セル
３１	偏光板
３２	偏光板
４１	偏光分離体
４２	偏光分離体
４３	ＰＥＴ層
４４	コレステレリック液晶層
４５	λ／４位相差層
４６	ＴＡＣ層
４７	偏光分離体
４８	ポリカーボネート樹脂層
４９	ポリメチルメタクリレート樹脂層
５０	偏光分離体
５１～５４	屈折率異方性を有する層
２１	光源
２２	導光体
２３	光散乱体
２４	反射シート
２５	拡散シート
２６	プリズムシート
２６ａ	プリズムシート

【図１】



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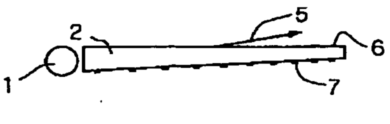

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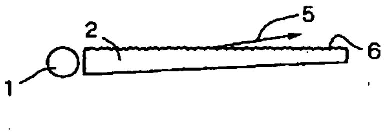

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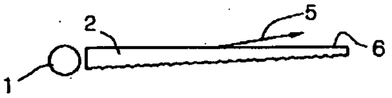

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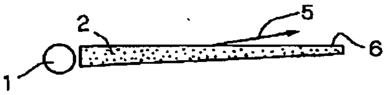

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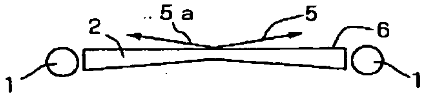

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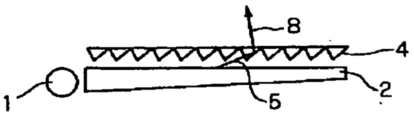

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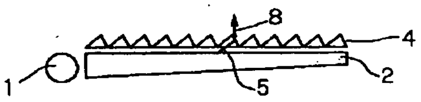

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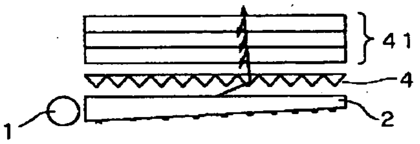

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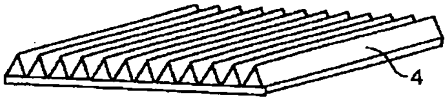

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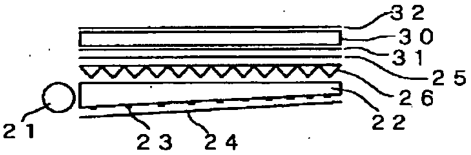

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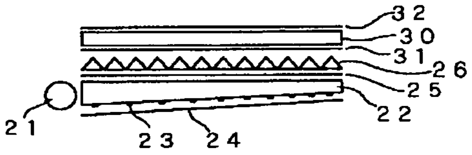

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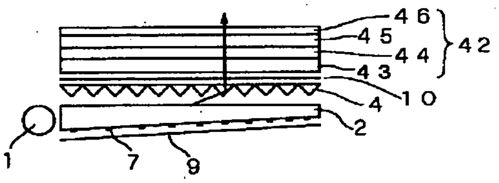

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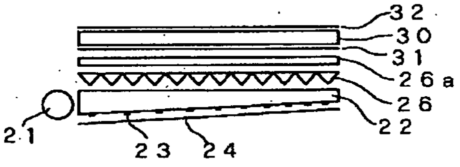

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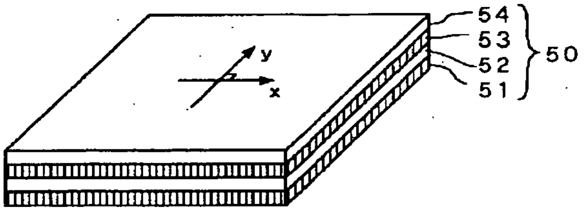

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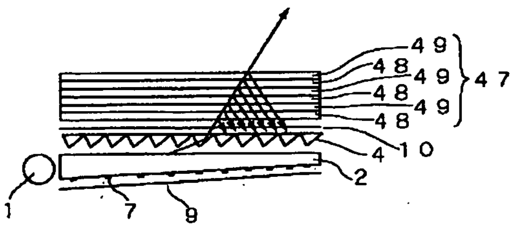

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(71)Applicant : DAINIPPON PRINTING CO LTD

(72)Inventor : KASHIMA KEIJI
ARAKAWA FUMIHIRO

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(30)Priority

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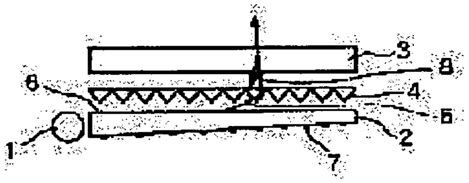
(54) BACKLIGHT AND LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce thickness and to improve mass-productivity with simple constitution by providing a light beam deflecting body deflecting and emitting light toward a polarized light separating body so that polarized light separating action may be maximum between a light transmission body and the polarized light separating body.

SOLUTION: This backlight is constituted of a light source 1, the light transmission body 2 from a side surface of which the light from the light source 1 is made incident and which emits the directive light having maximum intensity to the 1st specified direction 5, the polarized light separating body 3 having planar layer structure, and the light beam deflecting body 4 intervening between the body 2 and a polarized light separating film, and deflecting the light from the direction 5 to the 2nd specified direction 8 where the polarized light separating action of the separating body 3 is maximum and emitting it toward the separating body 3. The shape of the body 2 is made nearly like a plate and provided with a light scattering means. As for the light scattering means, a light scattering layer is provided on the emitting surface of the body 2 by printing, etc., and optically brought into contact or the light scattering layer 7 is provided on the surface on an opposite side to the emitting surface of the body 2 by printing, etc., and optically brought into contact.



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[Date of sending the examiner's decision of rejection]	20.05.2003
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[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	2003-11167
[Date of requesting appeal against examiner's decision of rejection]	18.06.2003
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CLAIMS

[Claim(s)]

[Claim 1] The light source and the transparent material which carries out incidence of the light from this light source from a side face, and carries out outgoing radiation of the directive light which has the maximum reinforcement in the 1st predetermined direction, the beam-of-light deviation object which it intervenes between the polarization segregant which has plane multilayer structure, and said transparent material and polarization segregant, and the light of said 1st predetermined direction is deflected in the 2nd predetermined direction in which the polarization segregation of a polarization segregant serves as max, and acts as Idemitsu towards a polarization segregant -- since -- the becoming back light.

[Claim 2] The back light according to claim 1 whose configuration a transparent material is abbreviation plate-like and the outgoing radiation side of a transparent material or whose outgoing radiation side is either in which the field of the opposite side of the outgoing radiation side of a transparent material or an outgoing radiation side is a split face, or the interior of a transparent material has light-scattering nature by the light-scattering layer touching the field of the opposite side optically as a light-scattering means in a transparent material.

[Claim 3] The back light according to claim 2 which is the prism sheet with which a beam-of-light deviation object has the concave convex which, as for the cross-section configuration side by the side of a transparent material, and/or a transparent material side, the cross-section configuration of the opposite side becomes from two or more unit prism.

[Claim 4] A back light given in any 1 term of claims 1-3 which the layer which the plane multilayer structure of a polarization segregant adjoins becomes from the three or more-layer layer from which a refractive index differs mutually.

[Claim 5] A back light given in any 1 term of claims 1-4 in which a polarization segregant has the rotatory-polarization selection layer which consists of a cholesteric-liquid-crystal layer, and lambda / 4 phase contrast layers.

[Claim 6] A back light given in any 1 term of claims 1-3 which the plane multilayer structure of a polarization segregant becomes from the three or more-layer layer from which the refractive-index difference between the adjoining layers in one direction and the refractive-index difference between the adjoining layers in the direction of another side differ in the optical oscillating direction of the 2-way which intersects perpendicularly mutually in a flat surface.

[Claim 7] The liquid crystal display using a back light given [as the tooth-back light source of a liquid crystal cell] in any 1 term of claims 1-6.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the back light with sufficient efficiency for light utilization used for a liquid crystal display etc., and a liquid crystal display.

[0002]

[Description of the Prior Art] In recent years, there is a remarkable thing in the spread of the liquid crystal displays using the back light as a display, and the liquid crystal display which is carrying out current spread is a method which modulates polarization light (it has obtained by making a polarizing plate penetrate light) in a liquid crystal layer. The typical configuration of the conventional back light and a liquid crystal display is shown in drawing 11 . If an operation of the back light conventional in this drawing is explained, the light by which outgoing radiation was carried out from the light source 21 will advance carrying out incidence to a transparent material 22, and repeating total reflection. A part of light which advances the inside of a transparent material can change a travelling direction with the light-scattering object 23, and it carries out outgoing radiation out of a transparent material. It is used as illumination light of the liquid crystal cell 30 which it was reflected with the reflective sheet 24 and the light which carried out outgoing radiation to drawing down from the transparent material was again returned to the interior of a transparent material, was condensed with the prism sheet 26 on the other hand after diffusing the light which carried out outgoing radiation to the drawing upper part with the diffusion sheet 25, and was pinched with polarizing plates 31 and 32 in the front flesh side. And it is used as the tooth-back light source of the liquid crystal cell 30 which had the front flesh side pinched with polarizing plates 31 and 32. Moreover, drawing 12 and drawing 1313 are also the configurations that a conventional back light and a conventional liquid crystal display are shown, and the diffusion sheet 25, the prism sheet 26, and sequence became reverse to drawing 11 in the back light in drawing 12 , and the prism side of a prism sheet turned to the transparent material side. Moreover, it is the configuration of having piled up another prism sheet 26a which has the triangle pole prism which intersects perpendicularly with the sense of the triangle pole prism of the prism sheet 26 on the prism sheet 26 in the back light in drawing 13 .

[0003] However, the polarizing plate by which current use is carried out had the low use effectiveness of light, in order to absorb the abbreviation one half of incident light. So, in order to make it satisfying brightness, incidence of more light was carried out to the polarizing plate. However, the power consumption of the light source not only increases that much, but the heat from the light source had a bad influence on liquid crystal, and there were various serious problems of being hard coming to see a display.

[0004] Various proposals like a less or equal have been made until it results [from such a viewpoint] in current. While was separated using the polarization segregant which divides the unpolarized light from the light source into the two linearly polarized lights which are in orthogonality relation mutually, and they also reuse the polarization light of another side while using polarization light directly. That is, it is carrying out incidence of polarization component of one of the two to a liquid crystal cell among the

polarization components separated by the polarization segregant, returning the polarization component of another side to a light source side, leading the light to a polarization segregant again by reflection etc., and reusing it, and is the technique which raises efficiency for light utilization.
** A polarization eliminator separates the technique of the indication to JP,4-184429,A into two polarization light which is in orthogonality relation mutually about the unpolarized light from light equipment, and carry out outgoing radiation of one polarization light towards a direct liquid crystal cell, make it reflect and reuse it as a light source light again, after returning and converging another polarization light on a light source side.
** In the back light of the indication to JP,6-265892,A, to the optical outgoing radiation side side of a field-like transparent material, establish a beam-of-light deviation object with which the light which carries out outgoing radiation becomes almost perpendicular to a field-like transparent material front face, and arrange a polarization separation means on it further.
** Arrange a polarization segregant to the outgoing radiation side side of the parallel flux of light-ized component which becomes JP,7-261122,A from the light-scattering transparent material which includes the volume field which has a wedge-like cross section in the back light of an indication again.
[0005]
[Problem(s) to be Solved by the Invention] However, there were the following problems in each above-mentioned conventional technique. ** For the liquid crystal display of a projection mold, a technique needs a spatial tooth space and cannot apply the configuration of the lighting system to the liquid crystal display of the flat-surface mold with which thin shape-ization is demanded. ** It was hard to call it what it was difficult for for the structure of a polarization segregant to be complicated although the efficiency for light utilization which was excellent when, as for the polarization segregant, the cross section formed a polarization detached core in the slant face of a pillar-shaped triangle-like prism array, although a technique is suitable for thin shape-ization is acquired, and for especially a cross section to form a polarization detached core in a part for the slant surface part of a pillar-shaped triangle-like prism array, and was excellent in mass-production nature. ** Although the outstanding efficiency for light utilization was acquired when the parallel flux of light-ized component which consists of a specific light-scattering transparent material including the volume field which has a wedge-like cross section as a transparent material was used, it is difficult for a technique to make a light-scattering transparent material into specific light-scattering ability, and it was hard to be called what can generally be used.
[0006] Then, the purpose of this invention is offering a polarization separation film as a polarization segregant which can also make thickness thin with a comparatively easy configuration, and is excellent in mass-production nature, and can improve the use effectiveness of light.
[0007]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem then, the back light of this invention The light source and the transparent material which carries out incidence of the light from this light source from a side face, and carries out outgoing radiation of the directive light which has the maximum reinforcement in the 1st predetermined direction, It intervened between the polarization segregant which has plane multilayer structure, and said transparent material and polarization segregant, and constituted from a beam-of-light deviation object which the light of said 1st predetermined direction is deflected in the 2nd predetermined direction in which the polarization segregation of a polarization segregant serves as max, and acts as Idemitsu towards a polarization segregant. Consequently, the use effectiveness of the light from the light source improves. Moreover, since the polarization segregant of this invention is a plane, thickness is not thinly bulky, either and it is made as for it to a thin back light. In addition, as a light-scattering means in a transparent material, the light-scattering layer touches the field of the opposite side optically, or the field of the opposite side is a split face, or a transparent material is a configuration is abbreviation plate-like and good [an outgoing radiation side or an outgoing radiation side / the outgoing radiation side of a transparent material, or an outgoing radiation side] for the interior of a transparent material to use what has light-scattering nature.

Moreover, a cross-section configuration [by the side of a transparent material] and/or transparent material side is good for a beam-of-light deviation object to use the prism sheet which has the concave convex which the cross-section configuration of the opposite side becomes from two or more unit prism. Moreover, the plane multilayer structure of a polarization segregant is good for the adjoining layer to consist of three or more-layer layers from which a refractive index differs mutually. In the optical oscillating direction of the 2-way a 2-way and the plane multilayer structure of ** and a polarization segregant cross at right angles mutually in a flat surface, it is good to constitute from a three or more-layer layer from which the refractive-index difference between the adjoining layers in one direction and the refractive-index difference between the adjoining layers in the direction of another side differ. Moreover, it is good to consider as the configuration which has the rotatory-polarization selection layer which consists of a cholesteric-liquid-crystal layer, and lambda / 4 phase contrast layers as a polarization segregant. And the liquid crystal display of this invention was considered as the configuration which used the above-mentioned back light as the tooth-back light source of a liquid crystal cell.

[0008] Hereafter, the back light and liquid crystal display of this invention are explained in full detail, referring to a drawing.

[0009] First, drawing 1 is the sectional view showing one gestalt of the configuration of the back light of this invention. As the back light of this invention is shown in this drawing, at least The light source 1, The transparent material 2 which carries out incidence of the light from this light source from a side face, and carries out outgoing radiation of the directive light which has the maximum reinforcement in the 1st predetermined direction, the beam-of-light deviation object 4 which it intervenes between the polarization segregant 3 which has plane layer structure, and said transparent material and a polarization separation film, and the light of said 1st predetermined direction is deflected in the 2nd predetermined direction in which the polarization segregation of a polarization segregant serves as max, and acts as Idemitsu towards a polarization segregant -- since -- it is constituted. The light source uses a cold cathode tube etc.

[0010] A transparent material 2 carries out outgoing radiation of the light source light which carried out ON light from the side face from an outgoing radiation side, and it has the property which carries out outgoing radiation of the directive light which has the maximum reinforcement in the 1st predetermined direction (sign 5 in drawing) so that it may illustrate to drawing 1 - drawing 6 . Especially if the quality of the material of a transparent material has the property to make light penetrate efficiently, it will not be limited, for example, they are acrylic resin, such as PMMA, polycarbonate resin, glass, etc. Like, the 1st predetermined direction 5 is the direction of the opposite side in the light source 1 which was shown in drawing 1 - drawing 5 and which has been arranged near the side edge side of a transparent material to the direction of a normal of a transparent material outgoing radiation side, when it generally thinks on the basis of the outgoing radiation side 6 of a transparent material. As an approach of carrying out outgoing radiation of the diffused light (this diffused light not being perfect diffusion light without directivity) from a transparent material as a directive light which has the maximum brightness, it has the configuration of a transparent material in the 1st predetermined direction 5, and a transparent material 2 is made to have with a light-scattering means as abbreviation plate-like (the shape of a wedge to which thickness becomes thin as it keeps away from the transparent material side edge side which arranges the light source strictly etc.). [whether the light-scattering layer which distributed light-scattering agents, such as a silica, is prepared by printing etc., and the outgoing radiation side of ** transparent material is made to contact optically into resin as a light-scattering means, and] ** (drawing 2) [whether into resin, the light-scattering layer 7 (it usually considers as the shape of a dot etc.) which distributed light-scattering agents, such as a silica, is formed by printing etc., and the field of the opposite side is optically contacted in the outgoing radiation side of a transparent material, and] Make the outgoing radiation side of a transparent material into a split face, make the field (rear face) of the opposite side into a split face with ** outgoing radiation side, or (drawing 4) inside ** transparent material ** As a light-scattering agent The matter of the translucency which has a different refractive index from the matter (for example, PMMA: refractive index 1.49) which constitutes most transparent materials What is necessary is just to adopt either which the whole light guide plate makes contain (for example, the silicone resin:refractive index 1.43) 1 or less % of the weight in magnitude with a particle diameter of 5 micrometers or less, and makes the ingredient of a transparent material itself light-scattering nature (drawing 5). If particle diameter is larger than 5 micrometers, even if the directivity of the outgoing radiation light from a transparent material will approach perfect diffusion light and a content will exceed 1 % of the weight, the brightness homogeneity of a transparent material outgoing radiation side gets worse and is not desirable. In addition, in the case of the so-called 2 LGT type back light which establishes the light source near the both-sides end face, in case thickness of a transparent material is made thin as it keeps away from the light source, a transparent material will consider as the configuration where a central part is the thinnest, and the 1st predetermined direction 5 and 5a of a 2-way will exist so that drawing 6 may show.

[0011] The beam-of-light deviation object 4 is a means which carries out ON light of the light of the 1st predetermined direction 5 which carries out outgoing radiation from a transparent material 2, and acts as Idemitsu as a light of the 2nd predetermined direction 8 to change the course of a beam of light, as shown in drawing 7 and drawing 8 . In the back light of the configuration of drawing 7 , the beam-of-light deviation object 4 is a prism sheet on which a cross section uses the triangular prism of the triangular triangle pole as unit prism, it has the prism structure which arranged many unit prism, and the cross-section configuration by the side of a transparent material constitutes the abbreviation configuration for V characters with the irregularity by prism structure. In this case, outgoing radiation of the beam of light of the 1st predetermined direction which carried out outgoing radiation is changed and carried out to a prism sheet in the 2nd predetermined direction by the total reflection after ON light and inside prism from a transparent material. In addition, in drawing 7 , the slant face of the cross-section triangle of triangle pole prism is the scalene triangle which made the light source side the steep incline rather than the anti-light source side. This is for standing an inclination for example, in the direction of a normal etc. with a beam-of-light deviation object about a directive light which inclines and acts as Idemitsu from a transparent material outgoing radiation side. Moreover, a transparent material side is a prism sheet which consists of many triangular prism with which it can set to the back light of the configuration of drawing 8 , and the cross-section configuration of the opposite side constitutes the abbreviation configuration for V characters contrary to drawing 7 as for the beam-of-light deviation object 4 (the prism sheets of drawing 7 are a front flesh side, on the contrary an arranged configuration about a prism side). In this case, outgoing radiation of the travelling direction is deflected and carried out as a beam of light of the 2nd predetermined direction 8 from a transparent material according to a refraction operation according the beam of light of the 1st predetermined direction 5 which carried out outgoing radiation to the prism of the plane of incidence of the beam-of-light deviation object 4, and an outgoing radiation side. In addition, in drawing 8 , the slant face of the cross-section triangle of triangle pole prism is the scalene triangle which made the anti-light source side the steep incline rather than the light source side. This is for standing for example, the direction of a normal, etc. and an inclination with a beam-of-light deviation object about a directive light which inclines and acts as Idemitsu from a transparent material outgoing radiation side. However, an isosceles triangle is sufficient when directivity is weak. If it is the ingredient of the property to make light penetrate efficiently, as these prism sheets, it will function, for example, there are acrylic resin, such as polyester resin, such as a polycarbonate (PC) and polyethylene terephthalate (PET), and polymethylmethacrylate (PMMA), glass, etc. The prism sheet which used ultraviolet-rays hardening resin and formed the prism configuration on base films, such as PET and PC, especially with the point which can form a detailed prism configuration with a sufficient precision is desirable, and it is desirable also from the point of having excelled most at mass-production nature. In this case, the larger one of the refractive index of the prism formed with ultraviolet-rays hardening resin is desirable, and it is specifically 1.5 or more still more preferably 1.4 or more. In addition, what is necessary is just to use the technique of an indication for JP,5-169015,A, in order to form a prism configuration with ultraviolet-rays hardening resin on a base film. That is, if it exfoliates from the roll intaglio which rotates the solidified ultraviolet-rays hardening resin with a base film by a prism configuration carrying out coating restoration of the ultraviolet-rays resin liquid, and subsequently to this supplying a base film to the rotating roll intaglio which has a reverse toothing-like crevice after being in the condition pressed and pressed to the roll intaglio, carrying out UV irradiation from on the resin liquid of a printing plate and stiffening resin liquid, a prism sheet can carry out continuation manufacture.

[0012] As a polarization separation means 3 of this invention, a configuration uses what has multilayer structure by the plane. One gestalt of the back light using the polarization segregant 41 of the plane multilayer structure of a refractive index is mutually shown in drawing 10 . The polarization segregant 41 has plane multilayer structure, and the refractive indexes of the plane matter layers which adjoined mutually differ. If a plane matter layer has translucency, especially the quality of the material will not be limited, but will be acrylic resin, such as polyester resin, such as polyethylene terephthalate (PET), a polycarbonate (PC), and polymethylmethacrylate (PMMA), TAC (cellulose triacetate), glass, a silica, ITO (Indium Tin Oxide), etc. The polarization segregant which has the plane multilayer structure from which a refractive index differs mutually uses the phenomenon (polarization segregation) in which the transmitted light and the reflected light polarize, in case a beam of light penetrates the interface from which a refractive index differs. The beam-of-light angle of incidence with which this polarization segregation is strengthened most is known as whenever [brewster's-angle]. In addition, if the plane matter (refractive-index n'>n) of one sheet in air (refractive index n= 1) is used when a beam-of-light angle of incidence is whenever [brewster's-angle] for example P wave intensity ratio of the S wave of the reflected light, and the transmitted light -- Ts/Tp=(2n' / 1+n'2) 4 In order to become and to obtain strong polarization segregation, although a plane matter layer is made into the multilayer more than two-layer at least, it is more preferably made into the multilayer structure of five or more layers three or more layers. In addition, light with the plane of vibration of light parallel [a P wave] to plane of incidence and an S wave mean light with the plane of vibration of light perpendicular to plane of incidence here. If unpolarized light carries out incidence to such a polarization segregant, while a beam of light with many P wave components will be penetrated among the light which carried out the linearly polarized light, it is reflected and the beam of light with many other S wave components advances towards a transparent material side. As for the transmitted light, plane of polarization of the reflected light is the linearly polarized light light which intersects perpendicularly. And the beam of light returned to the transparent material is changed into a condition [**** /-less] from a polarization condition, and again, outgoing radiation of it is carried out to a polarization segregant, and it is reused by the light-scattering function with which the transparent material was usually equipped to it. the beam of light by which outgoing radiation was carried out from the transparent material follows such a path -- very -- efficient -- a quantity of light loss -- it is few and polarization light is obtained. In addition, the conversion in the condition [**** /-less] from a polarization condition can also use the reflective sheet arranged to the rear-face side of a transparent material etc.

[0013] Moreover, as what has such structure, although the polarization separation means 3 of this invention is plane multilayer structure and it is constituted above two-layer at least, as shown in drawing 16 , the multilayer structure which carried out the laminating of the layer which has a refractive-index anisotropy so that the main shafts might differ by turns can also be used, for example. The layer which has a refractive-index anisotropy can be obtained by the approach of extending them that what is necessary is just the matter which shows refractive-index anisotropies within a field, such as polycarbonate system resin, polyester system resin, polyvinyl alcohol system resin, and cellulose acetate system resin, as indicated by JP,3-75705,A. 50 are the polarization segregant 50 with the plane multilayer-structure object with which the refractive-index difference between the adjoining layers in one direction differs from the refractive-index difference between the adjoining layers in the direction of another side in the optical oscillating direction of the 2-way which intersects perpendicularly mutually in a flat surface and which consists of a three or more-layer layer among drawing 16 . In this drawing, the configuration of four layers the layers 51-54 which it has carried out [configuration] the laminating of the refractive-index anisotropy to this order has shown notionally the polarization segregant 50 which consists of such a plane multilayer-structure object. For example, the refractive index to the beam of light which vibrates in the direction of a x axis of layers 51, 52, 53, and 54 is nX substantially. It is the same, therefore refractive-index difference deltanX between the adjoining layers in the direction of a x axis (= |nX-nX |) is zero substantially. And both the refractive indexes to the beam of light which vibrates in the direction of the y-axis of a layer 51 and a layer 53 are nY(s)1, and both the refractive indexes to the beam of light which vibrates in the direction of the y-axis of a layer 52 and a layer 54 are nY(s)2 (nY1 !=nY2), therefore there is no refractive-index difference deltanY between the adjoining layers in the direction of the y-axis (= |nY1-nY2|) substantially at zero. From these, it is refractive-index difference deltanX between the adjacent layers in the direction of a x axis. Refractive-index difference deltanY between the adjacent layers in the direction of the y-axis It is in a condition which differ substantially. Polarization is separable if the polarization segregant which consists of a plane multilayer-structure object with which the refractive-index difference between the adjacent layers in one direction differs from the refractive-index difference between the adjacent layers in the direction of another side in the optical oscillating direction of the 2-way which intersects perpendicularly mutually in such a flat surface is used. That is, reflection of the light which vibrates in the direction (for example, the direction of the y-axis) of [with a larger refractive-index difference] is larger than reflection of the light which vibrates in the direction (for example, the direction of a x axis) of [with a smaller refractive-index difference], and transparency of the light which vibrates in the direction (for example, the direction of a x axis) of [with a smaller refractive-index difference] is larger than transparency of the light which vibrates in the direction (for example, the direction of the y-axis) of [with a larger refractive-index difference]. And a more desirable mode is the case of zero substantially [the refractive-index difference of the smaller one]. Then, do not reflect the light which vibrates in the direction which gives the refractive-index difference of the smaller one, and it is penetrated. That is, in the optical oscillating direction of the 2-way which intersects perpendicularly mutually in a flat surface, in one direction (for example, the direction of a x axis), the refractive index between adjacent layers is substantially the same, and it is business in another direction (for example, the direction of the y-axis) about the polarization segregant which consists of plane multilayer structure from which the refractive-index difference between adjacent layers differs. If such a polarization segregant is used, polarization is separable in the more desirable condition (for example, light which penetrates the light which vibrates in the direction of a x axis, and vibrates in the direction of the y-axis reflection). Of course, the one even in this case of polarization separability ability where the value of the refractive-index difference of the larger one is larger is high. The reason is taken in the light which will vibrate in the direction of a x axis if the above-mentioned example explains, and since the refractive index of the plane multilayer-structure inside of the body is homogeneity substantially, surface reflection of the plane of incidence of a plane multilayer-structure object and an outgoing radiation side slight at two places only takes place. however, **** which the refractive index of the plane multilayer-structure inside of the body adjoins if it takes in the light which vibrates in the direction of the y-axis -- since it differs between the layers of that, surface (interface) reflection takes place to the plane of incidence of a plane multilayer-structure object and an outgoing radiation side, and a list between each layer of the plane multilayer-structure inside of the body. Therefore, the more there are many number of layerses of a polarization segregant, surface (interface) reflection takes place and, the more the light which vibrates in the direction of the y-axis is reflected. In this case, the incident angle of the beam of light with which polarization segregation serves as max is near [which was stood to the field of a plane multilayer-structure object] the direction of a normal. In addition, as an approach of measuring the condition of deviation separation, the linearly polarized light the linearly polarized light and the oscillating direction of light cross at right angles mutually can be used.

[0014] Moreover, as a polarization segregant which has the plane multilayer structure used as the polarization separation means 3 of this invention, the polarization separation film using liquid crystal, especially cholesteric liquid crystal can also be used. Although cholesteric liquid crystal discovers the above rotatory-polarization selection properties based on helical molecular arrangement, the light which carried out incidence in parallel with the helical shaft of a planar array is divided into the two circular polarization of lights, right handed rotation and levorotation light, one side penetrates, and another side is reflected. This phenomenon is known as circular polarization of light dichroism, and if the direction of the rotatory polarization of the circular polarization of light is suitably carried out to incident light, scatter reflection of the circular polarization of light with the same direction of the rotatory polarization as the helical shaft orientations of cholesteric liquid crystal will be carried out alternatively. The greatest rotatory-polarization light scattering is the wavelength lambda 0 of the following formula 1. It is generated.

[0015] lambda0 =nAV-p [Formula 1]

[0016] Here, it is an average refractive index within the flat surface where a helical pitch and p cross at right angles, and a helical shaft and nAV cross at right angles. Wavelength bandwidth deltalambda of the reflected light at this time is shown by the following formula 2.

[0017] delta lambda=delta n-p [Formula 2]

[0018] Here, it is deltan=n||-n**. The greatest refractive index within the field where a helical shaft and n|| cross at right angles, and n** are the greatest refractive indexes within a field parallel to a helical shaft. Moreover, wavelength lambdapsi of the selective-scattering light of the light which carried out incidence aslant to the helical shaft of a planar array is lambda 0. Comparing and shifting to a short wavelength side is known. It becomes possible [also using only the light of a certain wavelength alternatively, or also using also to the white light by controlling the helical pitch p of cholesteric liquid crystal, and refractive-index difference deltan so that it may be possible and wavelength bandwidth deltalambda of the reflected light may cover all light regions] using the above-mentioned property.

[0019] As cholesteric liquid crystal, the chiral NEMATEKKU liquid crystal compound which combined 2-methylbutyl radical of optical activity, 2-methyl butoxy radical, and 4-methyl hexyl group with the end group of nematic liquid crystal compounds, such as a Schiff base, an azo system, an ester system, and a biphenyl system, is desirable. Moreover, as cholesteric liquid crystal, macromolecule cholesteric liquid crystal is an ordinary temperature solid-state, and is the point which can fix the chiral physical properties, and is one of the desirable ingredients. Generally, although a polymer liquid crystal is the macromolecule which introduced into the location of a principal chain, a side chain or a principal chain, and a side chain the meso gene radical which presents liquid crystal, it can also obtain macromolecule cholesteric liquid crystal by introducing a cholesteryl radical into a side chain. In this case, in order to introduce a cholesteryl radical into a side chain, it is obtained by introducing into principal chain polymers, such as vinyl polymer, such as a polysiloxane or an ethylene-vinylacetate copolymer, through the spacer (molecule) which separates a suitable distance, or carrying out the polymerization of the vinyl monomer which has a cholesteryl radical.

[0020] One circular polarization of light component (right-handed rotation or left-handed rotation) is penetrated with cholesteric liquid crystal, and the circular polarization of light component of another side reflects the polarization segregation by cholesteric liquid crystal. As a liquid crystal display, since not the circular polarization of light but the linearly polarized light is used as incident light, it is usually desirable to use together 1 / 4 phase-contrast plate which changes the circular polarization of light into the linearly polarized light. In addition, the operation of this cholesteric liquid crystal, and 1 / 4 phase-contrast plate is reported by "SID 90 DIGEST, p110-110, Polariaing Color Filters Made From Cholesteric LCSiliconer", etc., for example. When using cholesteric liquid crystal, although a cholesteric-liquid-crystal layer, and lambda / 4 phase contrast layers may be used as a polarization separation means by which the air space and the matter layer of other solids were made to intervene in between, without making it stick, as for both layers, it is desirable [layers] to make it stick and to consider as the plane two-layer structure of two-layer structure at least. The polarization segregant to which the adhesion laminating of a cholesteric-liquid-crystal layer, and lambda / 4 phase contrast layers was carried out can be used as a film-like polarization segregant. Of course, lambda / 4 phase contrast layer side is made into a liquid crystal cell side, it makes a cholesteric-liquid-crystal layer side a transparent material side, and arrangement uses. Although it is theoretically good also as another object, when a quantity of light loss produces a cholesteric-liquid-crystal layer, and lambda / 4 phase contrast layers by reflection by the interface between a solid-state/gas, components mark also increase and it is not desirable. Although it depends for whenever [beam-of-light incident angle / with which the polarization segregation by the cholesteric-liquid-crystal layer is strengthened most] in the direction of orientation of cholesteric liquid crystal, it is most desirable from a viewpoint of the application to a liquid crystal display to arrange the direction of orientation of cholesteric liquid crystal so that it may be mostly in agreement in the direction of a normal which the maximum reinforcement of a polarization beam of light formed to the plane polarization segregant. In order to arrange the orientation of cholesteric liquid crystal, rubbing of the base materials, such as a high polymer film, was turned up by the well-known rubbing method, and cholesteric liquid crystal may be applied, or the ultraviolet-rays orientation technique using a well-known polarization light may be used.

[0021] In addition, when using the polarization segregation of cholesteric liquid crystal, it becomes that to which the polarization segregation by whenever [in the interface of a cholesteric-liquid-crystal layer / said brewster's-angle] and the polarization segregation of cholesteric liquid crystal were joined. In being near, it suits in slight strength but, as it becomes a bimodal property, when the direction is far. However, the direction is usually mostly in agreement in the direction of a screw axis of cholesteric structure.

[0022] As mentioned above, in the back light of this invention, using the beam-of-light deviation object which mentioned above the direction of outgoing radiation of directive light, such as the diffused light which has the maximum reinforcement in the 1st predetermined direction which carried out outgoing radiation from the transparent material, it can be made to be able to deviate in the 2nd predetermined direction (direction where the polarization segregation of a polarization segregant serves as max substantially), and can be made the polarization separation means of plane multilayer structure which was described above. Consequently, efficiency for light utilization can be improved taking advantage of the polarization separative power of a polarization separation means to the maximum extent. And since a polarization segregant is a plane, compared with the case where it has multilayers on a slant face, it becomes a thin back light and is not bulky.

[0023] In addition, further, the back light of this invention may use together a diffusion sheet, a lens sheet as well as [conventionally] a well-known back light (refer to drawing 11 - drawing 13), etc. if needed, and is not limited to this explanation in the range which does not deviate from the meaning of this invention.

[0024] And the liquid crystal display of this invention can consist of using the above-mentioned back light as the tooth-back light source of a liquid crystal cell.

[0025]

[Example] Hereafter, an example and the example of a comparison explain this invention further.

[0026] (Example 1) As shown in drawing 14 , as the transparent material 2 which carried out outgoing radiation of the diffused-light line which has the maximum reinforcement in the light source 1 and the direction of slant, and carried out printing formation of the dot-like light-scattering layer 7 in the rear face, and a polarization segregant 42 The plane multilayer-structure object which becomes order from the PET (polyethylene terephthalate resin) layer 43, the cholesteric-liquid-crystal layer (the direction of a screw axis of cholesteric structure is the direction of a normal of a PET stratification plane) 44, lambda / 4 phase contrast layers 45, and the TAC (cellulose-triacetate resin) layer 46 from a plane-of-incidence side, the beam-of-light deviation object 4 which is the prism sheet which unit prism consisted of triangle pole prism (scalene triangle to which the cross section made the light source side the steep incline rather than the anti-light source side), and turned prism irregularity to the transparent material side -- and The back light of a configuration of that have arranged the optical diffuse reflection sheet 9 which consists of a white polyethylene terephthalate sheet to the transparent material rear-face close-attendants side, and diffusing power has arranged the weak diffusion sheet 10 between said beam-of-light deviation objects 4 and polarization segregants 42 was produced. At this time, the polarization shaft of the beam of light which carries out outgoing radiation from the transparency directional axis and the polarization segregant 42 of polarization light of a polarizing plate by the side of the transparent material of a liquid crystal panel (not shown) was made in agreement, and it considered as arrangement which polarization light penetrates best. Total reflection of the beam of light from the light source is carried out in the transparent material 2 interior, it acts in the direction of slant as Idemitsu from an outgoing radiation side, and carries out total reflection of this beam of light within the prism of the beam-of-light deviation object 4, and it let the polarization segregant 42 pass after changing into the beam of light of almost facing up in a drawing, and it was made it to carry out incidence to the liquid crystal panel which has a TN liquid crystal between two polarizing plates.

[0027] When the brightness of the beam of light by which makes a liquid crystal panel the transparent mode and outgoing radiation is carried out from the polarizing plate on the front face of a panel was measured, as compared with the case where a back light as shown in conventional drawing 11 is used, the maximum brightness (brightness of the direction which gives maximum) improved 40%. The total thickness of the back light at this time was set to 6mm, and became 1/10 or less [of the total thickness at the time of using the so-called direct female mold back light].

[0028] (Example 2) In the back light of an example 1, on the beam-of-light deviation object, the cross section considered the sense of a prism concave convex as the opposite orientation configuration the liquid crystal cell side as unit prism, using the triangle pole prism of the isosceles triangle which is 90 degrees of vertical angles, and also the back light of an example 2 was produced like the example 1, and brightness was evaluated like the example 1 on it again. The maximum brightness improved 20%.

[0029] (Example 1 of a comparison) In the example 2, the back light constituted from arrangement of a polarization segregant and a prism sheet (prism side liquid crystal cell side) sequentially from the transparent material outgoing radiation side side was produced using the same polarization segregant, and brightness was evaluated like the example 1. There was little improvement in the maximum brightness as 5%.

[0030] (Example 3) As shown in drawing 15 , as a polarization segregant 47, the polycarbonate resin layer 48 and the polymethylmethacrylate resin layer 49 adjoined by turns, and like the example 1, others produced the back light and evaluated brightness like the example 1 using the polarization segregant which has the plane multilayer structure of a configuration of having carried out a total of 50-layer laminating. The maximum brightness improved 60%.

[0031] (Example 4) It replaced with the polarization segregant 42 of examples 1 and 2, and when the polarization segregant 50 which consists of 100 layers which carried out thermocompression bonding and carried out the laminating of what extended polyester resin as shown in drawing 16 so that the main shaft of the refractive index might intersect perpendicularly by turns was used, the respectively same improvement effectiveness in brightness as examples 1 and 2 was acquired again.

[0032] (Example 2 of a comparison) In examples 1-4, the more the polarization segregation of a polarization segregant shifted the maximum direction of a directive light which carries out incidence to a polarization segregant on the strength from the direction used as max, the more brightness fell. When especially the brightness fall at the time of shifting 10 degrees or more was remarkable and having been shifted 25 degrees or more, change of a color was observed clearly.

[0033]

[Effect of the Invention] According to this invention, the use effectiveness of light can be improved with a comparatively easy configuration. And since the polarization segregant of a back light is a plane, thickness can also be made thin and is the the best for thin-shape-izing of a liquid crystal display.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view showing one gestalt of the back light of this invention.
[Drawing 2] The sectional view showing one gestalt of a transparent material.
[Drawing 3] The sectional view showing other gestalten of a transparent material.
[Drawing 4] The sectional view showing other gestalten of a transparent material.
[Drawing 5] The sectional view showing other gestalten of a transparent material.
[Drawing 6] The sectional view showing other gestalten of a transparent material.
[Drawing 7] The sectional view showing one gestalt of a beam-of-light deviation object.
[Drawing 8] The sectional view showing other gestalten of a beam-of-light deviation object.
[Drawing 9] The perspective view showing the example of a configuration of a beam-of-light deviation object.
[Drawing 10] The sectional view showing one gestalt of the back light of this invention which used multilayer structure for the polarization separation means.
[Drawing 11] The sectional view showing the conventional back light and an example of a liquid crystal display.
[Drawing 12] The sectional view showing the conventional back light and other examples of a liquid crystal display.
[Drawing 13] The sectional view showing the conventional back light and other examples of a liquid crystal display.
[Drawing 14] The sectional view showing other gestalten of the back light of this invention using the multilayer structure by cholesteric liquid crystal for a polarization separation means.
[Drawing 15] The sectional view showing other gestalten of the back light of this invention which used the multilayer structure of use for the polarization separation means whenever [brewster's-angle].
[Drawing 16] The perspective view showing an example of the polarization segregant which has the plane multilayer structure which consists of a layer which has a refractive-index anisotropy.
[Description of Notations]
1 Light Source
2 Transparent Material
3 Polarization Segregant
4 Beam-of-Light Deviation Object
5 The 1st Predetermined Direction

6 Outgoing Radiation Side of Transparent Material
7 Light-Scattering Layer
8 The 2nd Predetermined Direction
9 Reflective Sheet
10 Diffusion Sheet
30 Liquid Crystal Cell
31 Polarizing Plate
32 Polarizing Plate
41 Polarization Segregant
42 Polarization Segregant
43 PET Layer
44 KORESU Tele Rucksack Liquid Crystal Layer
45 Lambda / 4 Phase Contrast Layers
46 TAC Layer
47 Polarization Segregant
48 Polycarbonate Resin Layer
49 Polymethylmethacrylate Resin Layer
50 Polarization Segregant
51-54 Layer which has a refractive-index anisotropy
21 Light Source
22 Transparent Material
23 Light-Scattering Object
24 Reflective Sheet
25 Diffusion Sheet
26 Prism Sheet
26a Prism sheet

[Translation done.]

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